FINAL
DYE TRACE REPORT

HOWE VALLEY LANDFILL
HARDIN COUNTY, KENTUCKY

Prepared by:

HATCHER-SAYRE, INC.
Lexington, Kentucky
November 24, 1993

Job No. 0064-001

U.S. EPA REGION IV

SDMS

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INTRODUCTION

As a result of the discovery of two new swallets during bedrock excavation at the Howe Valley Landfill Site, a dye trace study was initiated in June 1993. This report describes the results of the most recent dye trace study conducted at the Site. The study was conducted from June 14, 1993 to July 9, 1993.

BACKGROUND

Site Description

The Howe Valley Landfill Site is located in Hardin County, south of Vertrees, Kentucky. It lies 1.4 miles south of State Road 86 at the end of Tom Duvall Lane (Figure 1). The Site is located at the boundary of the Constantine and Howe Valley U.S. Geological Survey (USGS) quadrangle maps at coordinates of 37°40'05" N latitude and 86°07'30" W longitude. It consists of approximately 11 acres of sparsely vegetated land situated in a topographic basin. Approximately 2.5 acres of this site had been cleared for the landfilling of wastes.

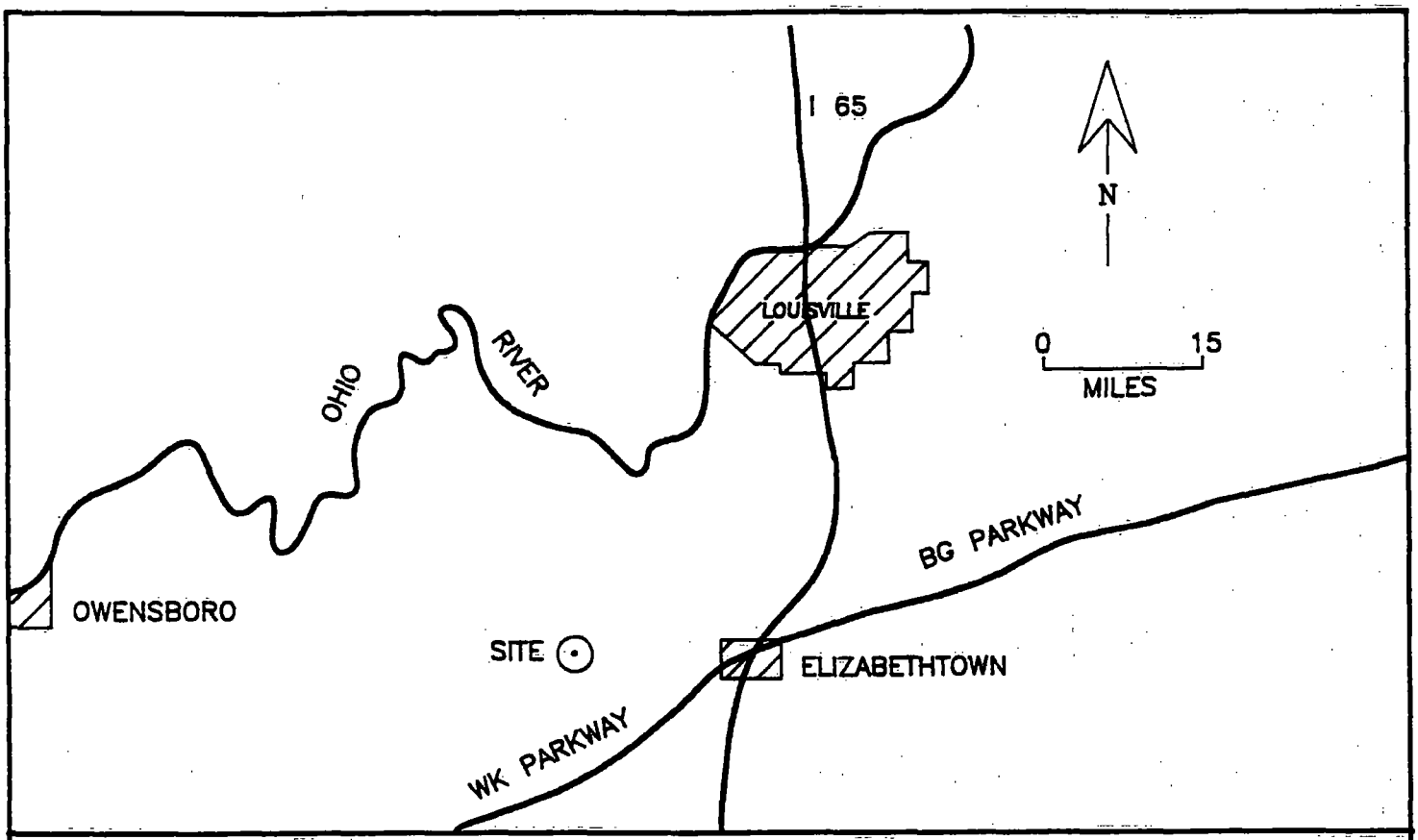
The Howe Valley Landfill Site is situated in karst terrane, and surface waters from the property drain into a sinkhole located on the site. Previous dye trace studies have indicated that the primary groundwater discharge point from the Site is Boutwell Spring, which is located approximately 1.85 miles south/southwest of the Site. Additional information regarding the physiography, hydrogeology, geology, demography, ecology, and soil types at the Site is contained in the Remedial Investigation/Feasibility Study (RI/FS) previously submitted to the United States Environmental Protection Agency (USEPA) (Hatcher-Sayre, Inc. 1990).

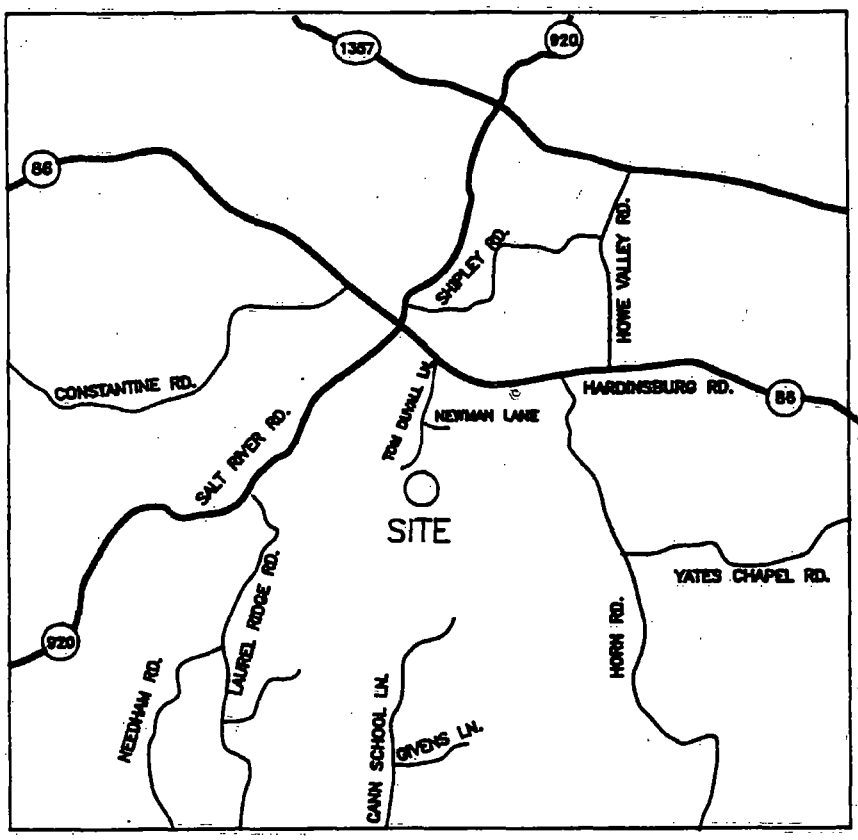
Site History

Kentucky Industrial Services, Inc. conducted industrial waste disposal operations at the Site, possibly as early as 1967. The Site was operated as an industrial waste landfill from 1967 to 1976 and was under permit by the state of Kentucky from 1970 to 1976. The site has essentially been inactive since 1976, with access limited but not restricted. Types of wastes reportedly disposed at the Site consisted of manufacturing sludges, plating sludges, galvanizing wastes, silicone polymers, insulation and insulation byproducts.

Based on the initial assessment of site and waste characterization activities, the following target compounds were identified for the Site:

- 1,1,1-Trichloroethane (1,1,1-TCA)
- Tetrachloroethene (PCE)
- 1,1-Dichloroethane (1,1-DCA)





N

ELIZABETHTOWN 10 MILES

0 2
MILES

SOURCE: HARDIN CO. ROAD MAP

DATE:	8/13/93
DRAWN BY:	P.D.H.
APPROVED BY:	A.S.C.
CLIENT NO.:	0064-001

0064-53

FIGURE 1

SITE LOCATION MAP

DOW CORNING CORPORATION
HOWE VALLEY, KENTUCKY

HATCHER-SAYRE, INC.
Consulting Engineers and Scientists

- 1,2-Dichloroethene (1,2-DCE)
- Chromium VI (Cr)
- Zinc (Zn)
- Copper (Cu)
- Cyanide (CN)

Site Geology and Hydrogeology

Geology

The underlying strata at the Howe Valley Landfill Site are part of a large belt of alternating beds of sandstone, shale, and soluble carbonates that extend northward into Indiana, west to Missouri and Indiana, and south to Tennessee in what is physiographically termed the Mississippian Plateau. The Howe Valley Site is underlain by the Paoli Limestone, a light gray, ledge-forming limestone, which is about 50 feet thick. Underlying the Paoli is the yellowish-gray to light gray Ste. Genevieve Limestone. Both limestones serve as aquifers, with more than three-fourths of the drilled wells rated as adequate for domestic water supply.

Regionally, strata dip toward the southwest at approximately 1 foot per 100 feet, and considerable faulting has occurred west of the Site. The two major faults in the area are the Pole Bridge Fault and the Mount Olive Fault, both located about 2 miles west of the Site. These faults trend northeast-southwest.

Soil

The soil type in the vicinity of the Site is the Caneyville-Hagerstown Association, which is comprised of moderately steep to gently sloping, well-drained soils and rock outcrops on hilly karst uplands (USDA 1979). Sinkholes and depressions characterize the area, and karst valleys and sinking streams are common.

The Caneyville soils, on hillsides, are well-drained and sloping to moderately steep (USDA 1979). They have a loamy plow layer and a clayey subsoil that is underlain by limestone at a depth of about 34 inches. The Hagerstown soils, on ridges and side slopes, are deep, well-drained, and gently sloping to moderately steep. They, too, have a loamy plow layer and a clayey subsoil.

Hydrogeology

Based upon geologic and topographic maps, the area's drainage pattern is typical of karst limestone environments with a relative absence of surface drainage north and northeast of the Site. The area north of the Site, including the area around Vertrees and to the northeast, is a sinkhole plain (Pennyroyal) which developed on the Ste. Genevieve and Paoli Limestones. The Site lies at the south end of an approximately 450-acre

watershed. Intermittent streams emanate from the ridges to the north, northeast, and east of the Site and flow into a series of sinkholes just northeast of the Site. Flow in these streams occurs during and shortly following precipitation events.

Surface drainage becomes more dense west and southwest of the Site and dendritic stream patterns can be observed in the area of the bordering sandstone ridges. Springs in the area apparently emanate from either the Beaver Bend or Paoli Limestones. Linders Creek flows west into the Rough River which flows southerly to the Green River and, eventually, to the Ohio River near Henderson, Kentucky.

Surface drainage in this area is essentially absent. Surface water drainage is primarily vertical through numerous small sinkholes, losing streams and surface percolation. Groundwater then moves toward base level through relatively discontinuous, sediment-choked vadose and phreatic cavities and small caves. Numerous dye test data indicate that subsurface flow is toward the south/southwest with an emergent point at Boutwell Spring. Boutwell Spring discharges to Linders Creek, which represents the southern base level toward which groundwater will move and eventually be discharged.

PREVIOUS DYE TRACE STUDIES

Three dye trace investigations have already been conducted at the Howe Valley Site. All three investigations were conducted under different hydrologic conditions, but the findings indicate that essentially all of the water entering the on-site sinkhole travels through a conduit system and emerges at Boutwell Spring #1 (hereinafter referred to as Boutwell Spring). Dye has never been detected at Boutwell Spring #2.

The first investigation was undertaken by the Kentucky Natural Resources and Environmental Protection Cabinet (KNREPC) during 1979. During this investigation, although it did not pinpoint Boutwell Spring, the state detected dye at the first Linders Creek monitoring point below Boutwell Spring 8 days after dye introduction. The estimated travel time through the system (about 1 foot/minute) indicated moderate flow conditions.

The second dye trace was conducted by Hatcher-Sayre, Inc. (formerly Hatcher Incorporated) in 1988 during drought conditions. As indicated previously, this investigation pinpointed Boutwell Spring as the point of dye emergence following dye detection at the three downstream Linders Creek monitoring locations. The estimated travel time during this low-flow period was 0.2 feet/minute.

The third dye trace was carried out under high-flow conditions during the spring of 1990. This investigation indicated, as did the two previous studies, that Boutwell Spring was the single emergent point for water entering the Howe Valley Landfill on-site sinkhole. During this high-flow period, dye was detected at Boutwell Spring in less than 24 hours, indicating a travel time of about 7 feet/minute.

It is apparent that any water entering the on-site sinkhole will emerge at Boutwell Spring. However, since there are a number of karst conduit systems in the area, it is important to confirm the flow direction and discharge location of water flowing into the newly identified swallets.

CURRENT DYE TRACE STUDY

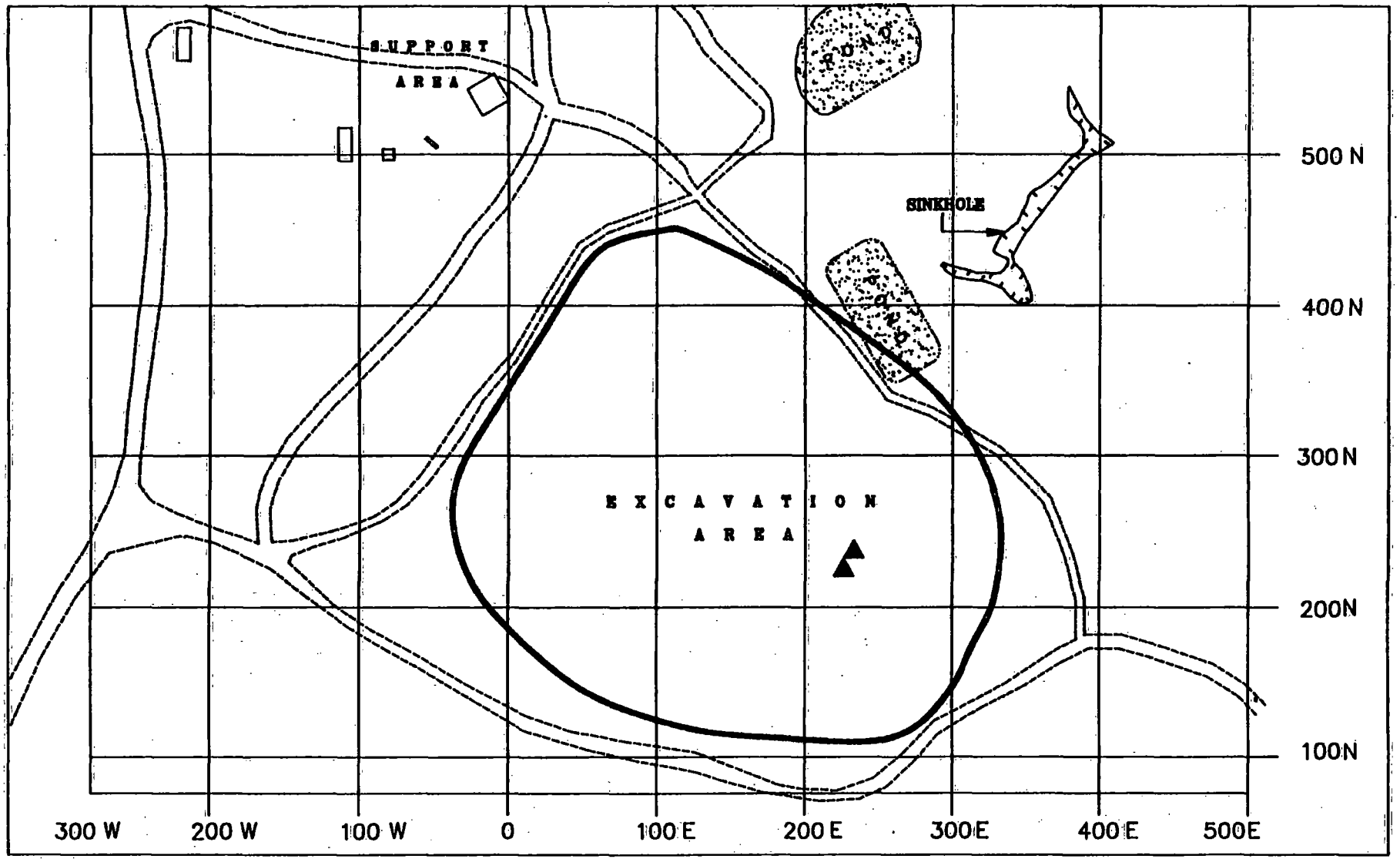
On June 14, 1993, following verbal approval from USEPA of a previously submitted work plan (Hatcher-Sayre, Inc. 1993), approximately 5 pounds of eosine OJ dye and approximately 1,000 gallons of water were instantaneously introduced into the larger of the two connected swallets (Figure 2) to evaluate the fate of water entering them. Upon completion of the dye introduction, the swallets were plugged with bentonite to prevent further infiltration of runoff or other liquids.

Background bug samples were not placed, collected and analyzed for the current dye trace study due to time constraints. Two new swallets were discovered in the excavation, which necessitated conducting the dye trace study immediately. Leaving the swallets open for any length of time could lead to the introduction of contaminated waters from the excavation, into the swallets, and finally into the groundwater system. In addition, it was possible that excavation in nearby areas would disturb the bedrock, resulting in the loss of the swallets and the dye injection point. Therefore, it was necessary to conduct the current dye trace study as soon as possible.

Background bug samples were previously installed, collected, and analyzed by Ewers Water Consultants in April 1993. These background bug samples were installed for a dye trace study to be conducted at a swallet discovered in the excavation in November 1992. The dye trace study was cancelled, however, after discovering that the swallet would not accept water at flows greater than one gallon per minute. As a result, only some of the background bug samples were analyzed. Appendix A contains the results of these analyses which indicate weak background concentrations of fluorescein were present in area waters at the Pirtle and Stiles Springs locations.

Eosine OJ dye was used instead of fluorescein dye as described in the Hatcher-Sayre, Inc. document entitled, *Final RD/RA Dye Trace Study Work Plan, Howe Valley Landfill, Hardin County, Kentucky*,, dated January 11, 1993. Eosine was selected for this dye trace study at the suggestion of Dr. Ewers, Eastern Kentucky University, since it is less commonly used than fluorescein and since it was detected in the background samples. Residual concentrations of fluorescein dye would probably be present since dye trace studies have previously been conducted in the area by the U.S. Geological Survey, Hatcher-Sayre, Inc., and others.

Prior to injection of the dye, 20 activated charcoal packets (bugs) were placed in selected wells, springs, and streams for dye detection. Table 1 and Figure 3 indicate the detector locations utilized in the current dye trace study. The detector locations chosen for



LEGEND

- SURFACE WATER COLLECTION POND
- ACCESS ROADS
- APPROXIMATE LOCATION OF SWALLETS DISCOVERED JUNE 1993

0 50' 100'

SCALE

DATE:	9/2/93
DRAWN BY:	P.D.H.
APPROVED BY:	A.S.C.
CLIENT NO.:	0064-001

FIGURE 2

MAP SHOWING LOCATION OF SWALLETS DISCOVERED IN JUNE 1993

HOWE VALLEY LANDFILL
HARDIN COUNTY, KENTUCKY

HATCHER-SAYRE, INC.
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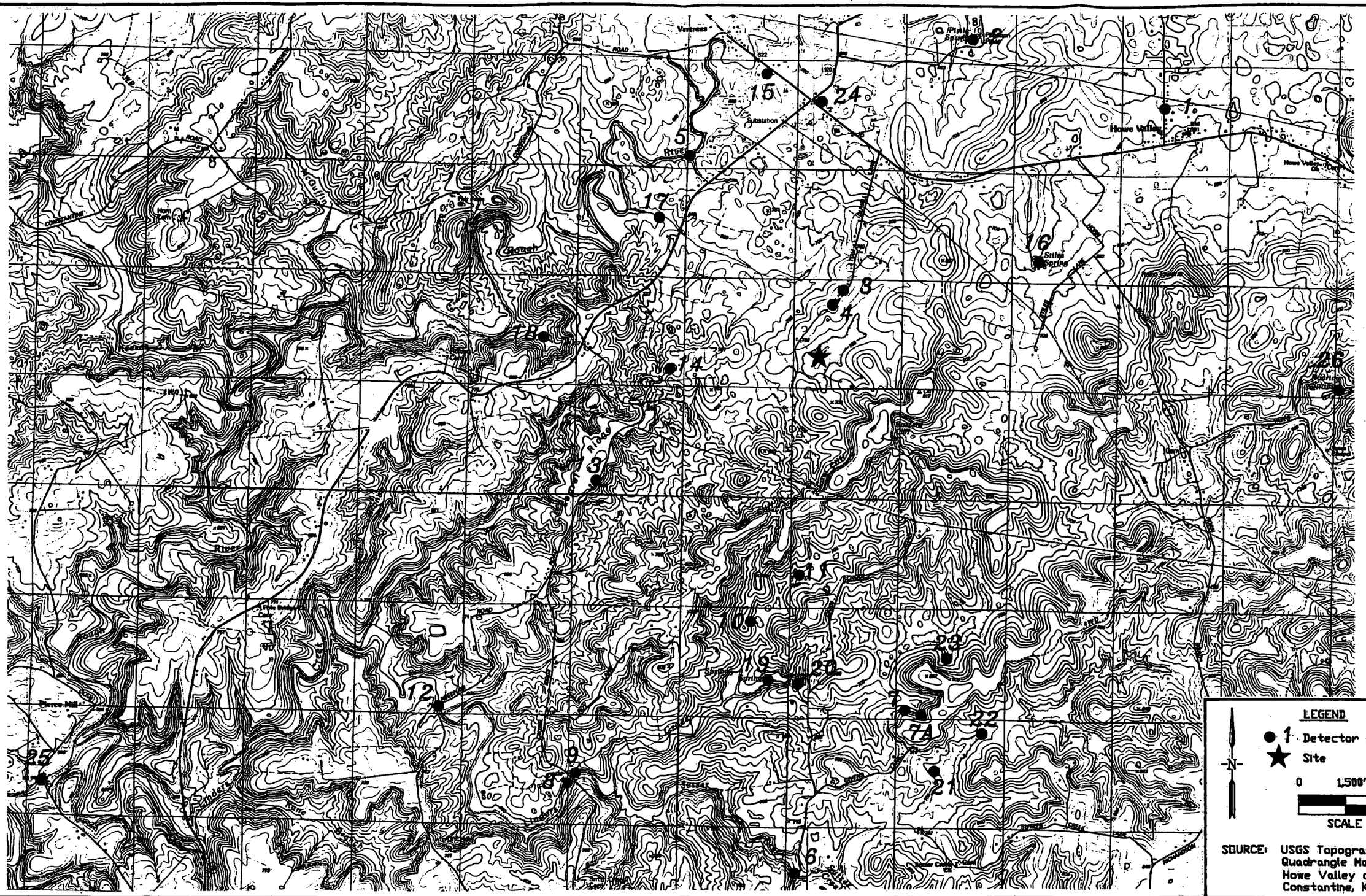
0064-57

TABLE 1
DETECTOR LOCATION INFORMATION, MODERATE FLOW STUDY
(JUNE 14 TO JULY 9, 1993)

Bug No.	Description
1	Youngblood Well (not used; inaccessible, residence unoccupied)
2	Pirtle Spring
3	L. Moore Well
4	C. Goodman Well
5	Rough River (Scott Goodman)
6	Sutzer Creek
7	Green Spring #1
7a	Green Spring #2
8	Linders Creek
9	Linders Spring
10	Goodman Spring #1
11	Goodman Spring #2
12	Linders Creek Bridge
13	E. Elliott Well
14	W. Stevens Well
15	Johnson Well (not used; toilet bowl cleaner used)
16	Stiles Spring
17	Rough River (across field)
18	Rough River (Myers)
19	Boutwell Spring #1
20	Boutwell Spring #2
21	Duncan Spring #1 (not used; permission not granted)
22	Duncan Spring #2 (not used; permission not granted)
23	Blair Spring #2 (not used; inaccessible, residence unoccupied)
24	Fields Grocery
25	Rough River (Pierce Mill)
26	Roaring Spring

See Figure 3 for dye detector locations.



DATE: 9/7/93	FIGURE 3
DRAWN BY: P.D.H.	MAP SHOWING DYE DETECTOR LOCATIONS AND PROJECT SITE
APPROVED BY: A.S.C.	DOW CORNING CORPORATION HOWE VALLEY LANDFILL HOWE VALLEY, KENTUCKY
CLIENT NO.: 0064-001	HATCHER-SAYRE, INC. *Consulting Engineers and Scientists*

the bugs were based on data generated during previous dye trace studies conducted in the area and site reconnaissance activities.

The Youngblood Well, Blair Spring #1 and Blair Spring #2 locations were not monitored during the current dye trace study since the residences were unoccupied, and permission was not granted to place bugs at these locations. The Johnson Well location was not used since a toilet bowl cleaner (with chlorine and dyes) was used at this site. Permission to access Duncan Spring #1 and Duncan Spring #2 was not granted. However, based upon site reconnaissance activities, five new dye detector locations were added; specifically, Green Spring #1, Green Spring #2, Fields Grocery, Rough River (Pierce Mill), and Roaring Spring. Detailed procedures and methods used during the current study are presented in the Final RD/RA Dye Trace Study Work Plan (Hatcher-Sayre, Inc. 1993).

After dye injection, the bugs were collected and replaced at regular intervals and analyzed for the presence of the dye. Charcoal bugs were collected on the following days:

- June 15, 1993
- June 17, 1993
- June 20, 1993
- June 25, 1993
- July 2, 1993
- July 9, 1993

Due to residents not being at home, not all of the detector locations were accessible on each day that samples were recovered; in some instances, bugs were left in place for longer periods of time (Fields Grocery, L. Moore Well, W. Stevens Well). Only three locations were monitored on July 9; Rough River (Scott Goodman), Sutzer Creek, and Rough River (Pierce Mill), since these locations had previously shown questionable traces of dye. Two samples were collected from each of these three locations on July 9; one sample (labeled B) had been in place for one week, and the other sample (labeled A) had been in place for two weeks before being retrieved on July 9.

Sample tags and chain of custody documentation were completed for all bug samples collected. Samples were transported to Ewers Water Consultants, Inc. (EWC) of Richmond, Kentucky, for analysis. Chain of custody documentation and laboratory results are contained in Appendices B and C, respectively. The Material Safety Data Sheet (MSDS) for eosine OJ dye is contained in Appendix D.

DATA ANALYSIS

The results of the current dye trace investigation are summarized in Table 2. Procedures and quality assurance/quality control methods utilized by the laboratory for analysis of the charcoal bugs are summarized in Appendix C. All precautions were taken by field and laboratory personnel to prevent cross-contamination of samples and false results.

TABLE 2

DYE TRACE RESULTS
(DYE TRACE STUDY - JUNE 14 TO JULY 9, 1993)

Detector Locations	Map Ref No.	Date Detector Collected					
		6/15/93	6/17/93	6/20/93	6/25/93	7/02/93	7/09/93
Rough River	5	-(1882)	-(1903)	-(1931)	?(1972)	x	t*+**(2094*2095**)
Fields Grocery	24	-(1883)	-(1902)	x	-(1977)	-(2038)	x
Pirtle Spring	2	-(1884)	-(1904)	-(1950)	-(1975)	-(2037)	x
Rough River	17	-(1885)	-(1905)	-(1932)	-(1973)	-(2035)	x
Stiles Spring	16	-(1886)	-(1906)	-(1948)	-(1974)	-(2034)	x
Rough River	25	-(1887)	-(1907)	?(1933)	+(1976)	x	t*t**(2092*2093**)
Linders Creek Bridge	12	-(1888)	-(1909)	+++(1934)	+++(1987)	++(2039)	x
Roaring Spring	26	-(1889)	-(1908)	-(1949)	-(1971)	-(2036)	x
Linders Creek	8	-(1890)	+(1911)	+++os(1935)	+++(1980)	++(2041)	x
Linders Spring	9	-(1891)	-(1913)	-(1936)	-(1979)	-(2040)	x
E. Elliott Well	13	-(1892)	-(1916)	-(1938)	-(1983)	-(2042)	x
C. Goodman Well	4	-(1893)	-(1912)	-(1947)	-(1978)	-(2000)	x
Rough River	18	-(1894)	-(1915)	-(1939)	-(1982)	x	x
Boutwell Spring #2	20	-(1895)	-(1919)	-(1940)	-(1969)	-(2045)	x
Goodman Spring #1	10	-(1897)	-(1921)	-(1943)	-(1989)	-(2048)	x
Goodman Spring #2	11	-(1896)	-(1920)	-(1942)	-(1988)	-(2047)	x
Boutwell Spring #1	19	-(1898)	+++os(1922)	+++os(1941)	+++os(1970)	+++(2046)	x
Green Spring #1	7	-(1899)	-(1917)	-(1944)	-(1986)	-(2043)	x
Green Spring #2	7a	-(1900)	-(1918)	-(1945)	-(1984)	?(2044)	x
Sutzer Creek	6	-(1901)	-(1923)	?(1946)	?(1985)	x	t*t**(2090*2091**)
L. Moore Well	3	x	-(1910)	x	x	-(2033)	x
W. Stevens Well	14	x	-(1914)	-(1937)	-(1981)	x	x

Note: Hatcher-Sayre sample number in parentheses. See Figure 3 for dye detector locations.

x	=	No sample collected	+	=	Positive
-	=	Negative	++	=	Very positive
?	=	Questionable trace	+++	=	Spectacularly positive
t	=	Trace	*	=	Bug sample collected after 2 weeks
os	=	Off scale	**	=	Bug sample collected after 1 week

As previously indicated, bug samples were collected and analyzed on June 15, 17, 20, and 25 and July 2 and 9, 1993. There was no detection of dye in any of the samples collected on June 15, approximately 24 hours after introduction of the dye. Three days after dye was introduced, it was detected at Boutwell Spring (off scale) and Linders Creek (positive).

Dye was detected off scale at Boutwell Spring throughout the course of the current dye trace study. Dye also continued to be detected at Linders Creek and Linders Creek Bridge. In addition, dye was detected at Rough River (Pierce Mill) on June 20 (questionable trace), June 25 (positive) and July 9, 1993 (trace). Questionable traces of dye were also detected at Rough River (Scott Goodman), Sutzer Creek, and Green Spring #2 during the latter portion of the dye trace study.

Questionable traces of dye were detected during the current study at Rough River (Scott Goodman), Sutzer Creek and Green Spring #2. The Rough River (Scott Goodman) and Sutzer Creek locations showed a trace of dye only after the bugs had been left in place for a minimum of 1 week. Dye concentrations present at these locations are considered minimal relative to the Boutwell Spring (off-scale) detection of dye just 3 days after dye introduction.

Dye detection at Boutwell Spring was expected during the current dye trace study since this location has been the primary discharge point from the Howe Valley Site in previous studies. The Linders Creek and Linders Creek Bridge detections were also expected since Boutwell Spring flows into Linders Creek, and the dye monitoring locations were downstream. The detection of dye at Rough River (Pierce Mill) is also logical, since this location is just downstream from where Linders Creek enters the Rough River.

Detections of dye at Rough River (Scott Goodman), Green Spring #2, and Sutzer Creek were not expected. The Rough River (Scott Goodman) location lies approximately 1.3 miles northwest of the dye input location. Although this location is slightly lower topographically, the dye route would have had to cross two or three inferred faults (unnamed faults) prior to being detected at this location. Furthermore, the dye monitoring location at Rough River (Scott Goodman) is located in the Ste. Genevieve Limestone and not in the Paoli Limestone as seen at Boutwell Spring.

Dye detection at Green Spring #2, located approximately 2 miles south/southeast of the Site, does not appear to be valid since Green Spring #2 outcrops approximately 40 to 50 feet above the dye injection point of approximately 650 feet above Mean Sea Level. Furthermore, this spring appears to emanate at the contact of the Beech Creek Limestone and the Elwren Sandstone, which are located considerably above (stratigraphically) the Paoli Limestone.

The detection of dye at Sutzer Creek also does not appear to be logical. Although this monitoring location (approximately 2.9 miles south of the Site) is topographically lower than the dye injection point, the creek bed is located on the Beaver Bend Limestone and

not on the Paoli Limestone. The Beaver Bend Limestone is located stratigraphically above the Paoli Limestone.

The estimated travel time from the point of dye injection to emergence at Boutwell Spring was 3 days. The estimated flow through the system was about 2.3 feet per minute. This rate represents moderate flow conditions relative to other dye trace studies conducted at the Site.

SUMMARY

The results of the summer 1993 dye trace study are consistent with previous dye trace studies conducted at the Site. Boutwell Spring appears to be the first and primary discharge point downgradient from the Howe Valley Landfill Site. From that point, Boutwell Spring flows into Linders Creek. Linders Creek then discharges into the Rough River at Pierce Mill.

Questionable dye was detected at some of the detector locations during the current dye trace study [Rough River (Scott Goodman), Sutzer Creek, and Green Spring #2]. Green Spring #2 had a questionable detection of dye on July 2, 1993. A trace of dye was detected at Rough River (Scott Goodman) and Sutzer Creek on July 9, 1993, after the charcoal detectors were left in place for a minimum of one week. Therefore, dye concentrations at these locations are considered minimal. It is also questionable whether dye from the current study emerged at these locations given the stratigraphic, structural, and topographic differences.

Based on the time of emergence (3 days), the estimated flow through the hydrologic system was 2.3 feet/minute (assuming a 1.85 mile distance). This represents moderate flow conditions as compared to previous dye trace studies conducted at the Site.

REFERENCES

Hatcher-Sayre, Inc. 1993. Final RD/RA Dye Trace Study Work Plan, Howe Valley Landfill, Hardin County, Kentucky.

Hatcher-Sayre, Inc. 1990. Howe Valley Landfill, Hardin County, Kentucky, Remedial Investigation/Feasibility Study.

U.S.D.A. 1979. Soil Survey of Hardin and Larue Counties, Kentucky. U.S.D.A. Soil Conservation Service.

U.S. Geological Survey. 1991. Constantine, Kentucky, Topographic Map. Scale 1:24000.

U.S. Geological Survey. 1991. Howe Valley, Kentucky, Topographic Map. Scale 1:24000.

APPENDIX A

BACKGROUND DYE TRACE RESULTS

EWC *Ewers Water Consultants Inc.*

160 Redwood Drive, Richmond, Kentucky 40475
Phone & Fax (606) 623-8464

Date: April 19, 1993

To: James D. Knauss Ph.D
Timothy J. Young M.S.
Hatcher - Sayre Inc.
3150 Custer Drive, Suite 301
Lexington, Kentucky 40502

From: Ralph O. Ewers Ph.D.

Subject: Howe Valley - Corning Project - Dye Study
Dye Background Results

Detector Site	Date	Flu	Eos	RWT	FB	DY
Scott Goodman	2-24-93	-	-	-		
Goodman #2	"	-	-	-		
Goodman House	"	-	-	-		
#1 Goodman	"	-	-	-		
#3 L Moore	"	-	-	-		
#2 Pirtle	"	B-	-	-		
#7 Green	"	-	-	-		
#7A Green	"	-	-	-		
#13 Elliots	"	-	-	-		
#14 Stevens	"	-	-	-		
#16 Stiles	"	B-	-	-		
#17 Hilton	"	-	-	-		
#25 Fields	"	-	-	-		
#26 Roaring	"	-	-	-		

ABBREVIATIONS

Dye
- \- Negative
- \+ Positive
- ++ Very Positive
- +++ Spectacularly Positive

Dye Background
- B- Weak Background
- B Background
- B+ Strong Background
- B++ Very Strong Background

Detector or Sample
- / Detector not exchanged
- NR Sample Not Recoverable

Dye Type
- (Flu) Fluorescein
- (RWT) Rhodamine-WT
- (DY) Direct Yellow 96
- (FB) Optical Brightener, FB 28
- (Eos) Eosine

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe-Valley
PROJECT NO.: 0.C.4-001
SAMPLER'S SIGNATURE: Kevin M Durham
PRINTED NAME: Kevin M Durham

	HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	SAMPLE TYPE (CHECK BOX) COMPOSITE	ANALYSES REQUIRED: Background Analysis	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
2	Pirtle Springs #2	2/24/93	12:00	water	1	X		X		X	
3	Rough River Sr Goodman #5	2/24/93	12:15	water	1	X		X		X	
4	Stiles Spring #16	2/24/93	1:00	"	1	X		X		X	
5	Flowing Spring #26	2/24/93	1:30	"	1	X		X		X	
16	UNT Rough River #17	2/24/93	1:50	"	1	X		X		X	
17	Green Spring #7	2/24/93	3:10	water	1	X		X		X	
18	Green Spring #7a	2/24/93	3:00	water	1	X		X		X	
19	Goodman Springs #10	2/24/93	4:20	water	1	X		X		X	
20	Goodman Spring #11	2/24/93	4:30	water	1	X		X		X	
21	E. Elliott #13	2/24/93	5:00	water	1	X		X		X	
22	Stevens #14	2/24/93	5:05	water	1	X		X		X	

RELINQUISHED BY (SIGNATURE)	DATE	TIME	RELINQUISHED TO (SIGNATURE)	SHIPPING COMPANY	SHIPPING TICKET NO.
Kevin M Durham	2/25/93	9:00	Kevin Durham 7:25		
				REMARKS: Hand Delivered	

CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE)	DATE	TIME

TURNAROUND REQUIRED: ☑ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☐ OTHER _____

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe - Valley
PROJECT NO.: 0[illegible]-001
SAMPLER'S SIGNATURE: Kevin M. Dunham
PRINTED NAME: Kevin M. Dunham

	HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	SAMPLE TYPE (CHECK BOX) COMPOSITE	ANALYSES REQUIRED: BTEX	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
3	Fields #25	2/24/93	5.15		1			X		X	
4	Moore #3	2/24/93	5.20		1			X		X	
5	Goodman Howe #4	2/24/93	5.45		1	X		X		X	

RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY	SHIPPING TICKET NO.
Kevin M Dunham	2/24/93	9:00	[illegible]		
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS: [illegible]	
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):		
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME	TURNAROUND REQUIRED ☐ 24 HOURS ☐ 48 HOURS	☐ NORMAL ☐ OTHER _____

APPENDIX B

CHAIN OF CUSTODY

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe Valley
PROJECT NO.: 0064-001
SAMPLER'S SIGNATURE: Paul Weaver Kevin Durham
PRINTED NAME: Paul Weaver Kevin Durham

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	COMPOSITE	ANALYSES REQUIRED: Eosine 03	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
1882	6/15/93	3:15	carbon	1		X	X	5 Rough River Scothboadman	X	
1883	6/15/93	3:18	carbon	1		X	X	24 Fields Grocery	X	
1884	6/15/93	3:30	carbon	1		X	X	2 Pirtle Spring	X	
1885	6/15/93	3:30	carbon	1		X	X	17 Rough River (Lacross Field)	X	
1886	6/15/93	3:49	carbon	1		X	X	16 Stiles Spring	X	
1887	6/15/93	3:50	carbon	1		X	X	25 Pierce Mill	X	
1888	6/15/93	4:03	carbon	1		X	X	12 Linders Creek Bridge	X	
1889	6/15/93	4:07	carbon	1		X	X	26 Roaring Springs	X	
1890	6/15/93	4:15	carbon	1		X	X	8 Linders Creek	X	
1891	6/15/93	4:20	carbon	1		X	X	9 Linders Spring	X	
1892	6/15/93	4:26	carbon	1		X	X	13 E. Elliott well	X	
1893	6/15/93	4:27	carbon	1		X	X	4 C. Goodman well	X	

Paul Weaver RELINQUISHED BY (SIGNATURE):	6/16/93 DATE	9:00 TIME	RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY	SHIPPING TICKET NO.
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS:	
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):		
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME	TURNAROUND REQUIRED ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☑ OTHER 72 Hours	

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe Valley
PROJECT NO.: 0064-001
SAMPLER'S SIGNATURE: Paul Weaver Kevin Durham
PRINTED NAME: Paul Weaver Kevin Durham

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	SAMPLE TYPE (CHECK BOX) COMPOSITE	ANALYSES REQUIRED: E. Coli 03	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
1894	6/15/93	4:57	carbon	1		X	X	18 Rough River (Myers)	X	
1895	6/15/93	5:18	carbon	1		X	X	20 Barkwell Spring #2	X	
1896	6/15/93	5:36	carbon	1		X	X	11 Goodman Spring #2	X	
1897	6/15/93	5:47	carbon	1		X	X	10 Goodman Spring #1	X	
1898	6/15/93	6:15	carbon	1		X	X	19 Boutwell Spring #1	X	
1899	6/15/93	6:30	carbon	1		X	X	7 Green Spring #1	X	
1900	6/15/93	6:30	carbon	1		X	X	7a Green Spring #2	X	
1901	6/15/93	6:40	carbon	1		X	X	6 Sutzer Creek	X	

RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY	SHIPPING TICKET NO.
Paul Weaver	6/16/93	7:00			
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS:	
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):		
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME	TURNAROUND REQUIRED: ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☒ OTHER 72 Hours	

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe Valley
PROJECT NO.: 0064-001
SAMPLER'S SIGNATURE: Paul Weaver Kevin Durham
PRINTED NAME: Paul Weaver Kevin Durham

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	SAMPLE TYPE (CHECK BOX) COMPOSITE	ANALYSES REQUIRED: Eosine 03	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
1902	6/17/93	3:13	carbon	1		X	X	24 Fields Grocery	X	
1903	6/17/93	3:15	carbon	1		X	X	5 Scott Goodman Rough River	X	
1904	6/17/93	3:25	carbon	1		X	X	2 Pettle Spring	X	
1905	6/17/93	3:37	carbon	1		X	X	17 Rough River (across field)	X	
1906	6/17/93	3:40	carbon	1		X	X	16 Styles Spring	X	
1907	6/17/93	3:55	carbon	1		X	X	25 Pierce Mill	X	
1908	6/17/93	3:57	carbon	1		X	X	26 Roaring Spring	X	
1909	6/17/93	4:07	carbon	1		X	X	12 Landers Creek Bridge	X	
1910	6/17/93	4:16	carbon	1		X	X	3 L. Moore Well	X	
1911	6/17/93	4:17	carbon	1		X	X	8 Landers Creek	X	
1912	6/17/93	4:20	carbon	1		X	X	4 C. Goodman well	X	
1913	6/17/93	4:22	carbon	1		X	X	9 Landers Spring	X	

RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY	SHIPPING TICKET NO.
Paul Weaver	6/17/93	7:58	Robert L Tarr		
Robert L Tarr	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS:	
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):		
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME		

TURNAROUND REQUIRED: ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☒ OTHER 72 hr

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe Valley
PROJECT NO.: 0064-001
SAMPLER'S SIGNATURE: Paul Weaver Kevin Durham
PRINTED NAME: Paul Weaver Kevin Durham

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	SAMPLE TYPE (CHECK BOX) COMPOSITE	ANALYSES REQUIRED: Lead	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
1914	6/17/93	4:57	carbon	1		X	X	14 W. Stevens well	X	
1915	6/17/93	4:59	carbon	1		X	X	18 Rough River (Myers)	X	
1916	6/17/93	5:00	carbon	1		X	X	13 E. Elliot	X	
1917	6/17/93	5:30	carbon	1		X	X	7 Green Spring #1	X	
1918	6/17/93	5:30	carbon	1		X	X	7a Green Spring #2	X	
1919	6/17/93	5:46	carbon	1		X	X	20 Boatwell Spring #2	X	
1920	6/17/93	5:59	carbon	1		X	X	11 Goodman Spring #2	X	
1921	6/17/93	6:11	carbon	1		X	X	10 Goodman Spring #1	X	
1922	6/17/93	6:36	carbon	1		X	X	19 Boatwell Spring #1	X	
1923	6/17/93	6:44	carbon	1		X	X	6 Sutzer Creek	X	

Paul W Weaver — RELINQUISHED BY (SIGNATURE):	6/18/93 — DATE	7:58 — TIME	Robert L Turner — RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY: — SHIPPING TICKET NO.:
Kevin Durham — RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS:
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME	TURNAROUND REQUIRED: ☐ 24 HOURS ☐ NORMAL ☒ OTHER 72 hour ☐ 48 HOURS

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: [illegible]
PROJECT NO.: [illegible]
SAMPLER'S SIGNATURE: Paul Weaver
PRINTED NAME: [illegible]

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	COMPOSITE	ANALYSES REQUIRED: Lead	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
1151 1431	1/14/93	3:20	[illegible]	1		X	X	[illegible]	✓	
1 17 1432		3:40		1		X	X	[illegible]	✓	
1 14 1433		3:55		1		X	X	[illegible]	✓	
1 12 1434		4:10		1		X	X	[illegible]	✓	
1 8 1435		4:19		1		X	X	[illegible]	✓	
1 9 1436		4:24		1		X	X	[illegible]	✓	
1 14 1437		4:50		1		X	X	[illegible]	✓	
1 13 1438		4:57		1		X	X	[illegible]	✓	
1 18 1439		4:50		1		X	X	[illegible]	✓	
1 20 1440		5:14		1		X	X	[illegible]	✓	
1 19 1441		5:24		1		X	X	[illegible]	✓	
1 11 1442	↓	5:42	↓	1		X	X	[illegible]	✓	

	DATE	TIME		
Paul Weaver — RELINQUISHED BY (SIGNATURE):	1/20/93	10:52	[illegible] — RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY:
[illegible] — RELINQUISHED BY (SIGNATURE):	[illegible]	[illegible]	[illegible] — RELINQUISHED TO (SIGNATURE):	SHIPPING TICKET NO.
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS:
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME	

TURNAROUND REQUIRED: ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☑ OTHER 72 hour

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Flow Valley
PROJECT NO.: 0004-001
SAMPLER'S SIGNATURE: [signature]
PRINTED NAME: [signature]

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	SAMPLE TYPE (CHECK BOX) COMPOSITE	ANALYSES REQUIRED: Lead	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
H 1	1443	5 52	Water	1		X	X	Coon Spring #1	X	
H 1	1444	25		1		X	X	Coon Spring #1	X	
H 2a	1445	25		1		X	X	Coon Spring #2	X	
H 2	1446	41		1		X	X	Sulzer Creek	X	
H 4	1447	3.18		1		X	X	C. Goodman	X	
H 16	1448	3.31		1		X	X	Hill's Spring	X	
H 2C	1449	3.41		1		X	X	Koontz Spring	X	
H 2	1450	4:09	↓	1		X	X	Hill's Spring	X	

RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):
[signature]	6/20/97	10:52	[signature]
[signature]	6/20/97	1052	[signature]
	DATE	TIME	RELINQUISHED TO (SIGNATURE):

SHIPPING COMPANY:

SHIPPING TICKET NO.:

REMARKS:

CONTRACT LAB:

RECEIVED FOR LAB BY (SIGNATURE):

DATE:

TIME:

TURNAROUND REQUIRED: ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☒ OTHER 72 hour

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe Valley
PROJECT NO.: 0064-001
SAMPLER'S SIGNATURE: Paul Weaver / Kevin Durham
PRINTED NAME: Paul Weaver Kevin Durham

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	COMPOSITE	ANALYSES REQUIRED: Ecoli O157	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	SPECIFY CHEMICALS
1969	6/25/93	2:05	carbon	1		X	X	20 Boutwell Spring #2	X	
1970	6/25/93	2:23	carbon	1		X	X	19 Boutwell Spring #1	X	
1971	6/25/93	3:06	carbon	1		X	X	26 Roaring Springs	X	
1972	6/25/93	3:15	carbon	1		X	X	S Rough River (S. Goodman Rd)	X	
1973	6/25/93	3:26	carbon	1		X	X	17 [redacted] Rough River Trib (across field)	X	
1974	6/25/93	3:27	carbon	1		X	X	16 Stiles Spring	X	
1975	6/25/93	3:46	carbon	1		X	X	2 Pirtle Springs	X	
1976	6/25/93	3:50	carbon	1		X	X	25 Pierce Mill	X	
1977	6/25/93	3:57	carbon	1		X	X	24 Fields Cro.	X	
1978	6/25/93	4:08	carbon	1		X	X	4 C. Goodman well	X	
1979	6/25/93	4:15	carbon	1		X	X	9 Linders Spring	X	
1980	6/25/93	4:20	carbon	1		X	X	8 Linders Creek	X	

RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY	SHIPPING TICKET NO.
Paul Weaver	6/26/93	12:45	Robert Hunt		
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS:	
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):		
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME	TURNAROUND REQUIRED: ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☒ OTHER 72 hour	

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe Valley
PROJECT NO.: 0064-001
SAMPLER'S SIGNATURE: Paul Weaver / Kevin Durham
PRINTED NAME: Paul Weaver Kevin Durham

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	SAMPLE TYPE (CHECK BOX) COMPOSITE	ANALYSES REQUIRED: EDB	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
1981	6/25/93	4:46	carbon	1		X	X	14 Steven's well	X	
1982	6/25/93	4:18	carbon	1		X	X	18 Rough River (Meyers)	X	
1983	6/25/93	4:52	carbon	1		X	X	13 E. Elliot well	X	
1984	6/25/93	5:14	carbon	1		X	X	7a Green Spring 7a	X	
1985	6/25/93	5:15	carbon	1		X	X	6 Sutzer Creek	X	
1986	6/25/93	5:18	carbon	1		X	X	7 Green Spring 7	X	
1987	6/25/93	4:06	carbon	1		X	X	12 Linders Creek Bridge (Archer)	X	
1988	6/25/93	6:02	carbon	1		X	X	11 Goodmans Springs #2	X	
1989	6/25/93	5:55	carbon	1		X	X	10 Goodmans Spring #1	X	

RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY	SHIPPING TICKET NO.
Paul Weaver	6/26/93	12:45	Robert C. Turner		
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS:	
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):		
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME	TURNAROUND REQUIRED: ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☒ OTHER 72 hours	

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe Valley
PROJECT NO.: 0064-001
SAMPLER'S SIGNATURE: Paul Weaver
PRINTED NAME: Paul Weaver

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	COMPOSITE	ANALYSES REQUIRED: Erbine 07	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
2000	7/2/93	9:53	carbon	1		X	X	4 C. Goodmon well	X	
2033		10:00		1		X	X	3 L. Moore well	X	
2034		10:07		1		X	X	16 Styles Spring	X	
2035		10:18		1		X	X	17 Rough River (across fields)	X	
2036		10:24		1		X	X	26 Roaring Springs	X	
2037		10:52		1		X	X	2 Pirtle Spring	X	
2038		11:00		1		X	X	24 Fields Gro	X	
2039		11:01		1		X	X	12 Lindsey Creek Bridge (Vandiver Cr.)	X	HCl
2040		11:11		1		X	X	9 Lindsey Spring	X	
2041		11:17		1		X	X	8 Lindsey Creek	X	HCl
2042	↓	12:28	↓	1		X	X	13 E. Elliot well	X	
2043	7/2/93	12:46	carbon	1		X	X	7 Green Spring	X	

RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY	SHIPPING TICKET NO.
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS:	
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):		
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME	TURNAROUND REQUIRED: ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☒ OTHER 72 hour	

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe Valley
PROJECT NO.: 0064-001
SAMPLER'S SIGNATURE: Paul Weaver
PRINTED NAME: Paul Weaver

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	SAMPLE TYPE (CHECK BOX) COMPOSITE	ANALYSES REQUIRED: Fecal Coli	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
2044	7/2/93	12:46	water	1		X	X	30 Green Spring	X	
2045	↓	1:01	↓	1		X	X	20 Boutwell Spring #2	X	
2046	↓	1:06	↓	1		X	X	19 Boutwell Spring #1	X	
2047	↓	1:19	↓	1		X	X	11 Goodman Spring #2	X	
2048	7/2/93	1:31	water	1		X	X	10 Goodman Spring #1	X	

RELINQUISHED BY (SIGNATURE):	DATE: 7/2/93	TIME: 1:31	RELINQUISHED TO (SIGNATURE):	SHIPPING COMPANY	SHIPPING TICKET NO.
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):	REMARKS:	
RELINQUISHED BY (SIGNATURE):	DATE	TIME	RELINQUISHED TO (SIGNATURE):		
CONTRACT LAB	RECEIVED FOR LAB BY (SIGNATURE):	DATE	TIME	TURNAROUND REQUIRED: ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☒ OTHER 2 hour	

HATCHER–SAYRE, INC.

CHAIN OF CUSTODY RECORD

PROJECT: Howe-Valley
PROJECT NO.: 0064-001
SAMPLER'S SIGNATURE: Kevin M. Durham
PRINTED NAME: Kevin M. Durham

HATCHER–SAYRE, INC. SAMPLE NO.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	SAMPLE TYPE (CHECK BOX) GRAB	SAMPLE TYPE (CHECK BOX) COMPOSITE	ANALYSES REQUIRED: Ecosite QT	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS
2090	7/2/93	5:05	Carbon				X	Sutzer creek (A)	X	
2091		6:06					X	Sutzer creek (B)	X	
2092		5:24					X	Pierce mill (A)	X	
2093		5:26					X	Pierce mill (B)	X	
2094		5:45					X	Scott Goodman-Rough River (A)	X	
2095							X	Scott Goodman-Rough River (B)	X	

Kevin M. Durham (RELINQUISHED BY (SIGNATURE))	7/6/93 (DATE)	(TIME)	(RELINQUISHED TO (SIGNATURE))	Hand (SHIPPING COMPANY)	(SHIPPING TICKET NO.)
(RELINQUISHED BY (SIGNATURE))	(DATE)	(TIME)	(RELINQUISHED TO (SIGNATURE))	REMARKS:	
(RELINQUISHED BY (SIGNATURE))	(DATE)	(TIME)	(RELINQUISHED TO (SIGNATURE))		
(CONTRACT LAB)	(RECEIVED FOR LAB BY (SIGNATURE))	(DATE)	(TIME)	TURNAROUND REQUIRED ☐ 24 HOURS ☐ 48 HOURS ☐ NORMAL ☐ OTHER	

APPENDIX C

LABORATORY REPORT

EWC Ewers Water Consultants Inc.

160 Redwood Drive, Richmond, Kentucky 40475
Phone & Fax (606) 623-8464

Date: June 18, 1993

To: Hatcher Sayre- Young/Knaus

From: Dr. Ralph Ewers

Subject: Dye Detectors, Howe Valley - Corning Project

The attached lists give the results of analyses for eosine dye performed on activated charcoal dye detectors supplied by H-S and delivered to EWC.

LABORATORY PROCEDURES and QUALITY ASSURANCE/QUALITY CONTROL

STORAGE

Prior to analysis, samples are stored in a controlled refrigerator or sample cabinet under the sole control of the analyst or other appropriate laboratory personnel whose signatures appear on the custody transfer record.

RECORDS

The sample sets are assigned a laboratory number, and the custody transfer record is added to the laboratory custody records. Paper documentation generated by the analytical instruments is added to the Laboratory custody records.

INSTRUMENTATION

A Shimadzu spectro-fluoro-photometer (spectrofluorometer) is used for dye analyses. This instrument is used in accordance with the manufacturer's instructions. Samples are equilibrated to ambient laboratory temperature, and analyzed at that temperature.

CUVETS

Disposable cuvets of glass or plastic are used for routine dye determinations. Each batch of cuvets is tested for the presence of dye by filling two randomly selected cuvets with elutant and analyzing spectrofluorometrically. EWC has never encountered a case of dye contamination in cuvets. When necessary, non-disposable cuvets are used. These are cleaned by brushing in Sparkleen solution, followed by a tap water rinse, a distilled water rinse for 10 min and a final distilled deionized water rinse.

DYE IDENTIFICATION

Dye identification is performed by synchronous excitation-emission scanning. An excitation-emission interval of 16nm is used for rhodamine-WT (AR-388), eosine (AR-87) and fluorescein (AY-73). A scan range of 470nm to 600nm excitation is normally used.

Fluorescence wavelength standards are prepared from the most recently available samples of dye from the EWC suppliers. The wavelength of maximum emission for most dyes dye is sensitive to the chemical characteristics of the water in which it is dissolved. The standards for analysis of water samples are prepared in de-chlorinated laboratory tap water. This is a consistent bicarbonate water. Standards for analysis of elutant from charcoal detector packets is prepared in the elutant appropriate for the dye.

SAMPLE ORDER

Standards and samples are customarily analyzed in the following order:

1- Laboratory water samples,
2- Elutants, if used,
3- Standards,
4- Blanks,
5- Samples of presumed low concentration,
6- Samples of presumed high concentration.

All positive analyses of samples near the practical detection limit are verified with additional analyses in fresh cuvets.

CHARCOAL DETECTORS

Activated charcoal dye detector packets are treated in the following way:

1- Vigorous tap water rinse,
2- Remove excess water by manual centrifugal extraction,
3- Dry the detectors in a controlled dye-free drying cabinet, or a secure room,
4- Withdraw 3 g of the activated charcoal into a disposable pre-labeled plastic container,
5- Elute the dye with 6 ml of Smart solution (Smart, 1972) for rhodamine-WT and fluorescein or Ewers solution (proprietary) for eosine for a period of 1 hour, covered,
6- Decant the elutant into a clean cuvette,
7- Analyze spectrofluorometrically.

The reserved charcoal is stored in labeled Zip Lock bags for later analysis if required or returned to the client when requested.

The analysis of elutant from dye detector packets is at best semi-quantitative relative to the amount of dye contained in the water passing over the detector. The quantity of dye adsorbed by a detector is a function of the temperature and velocity of the water passing over the detector, the duration of contact with the water containing dye, the quantity and species of molecules

competing with the dye for the charcoal acceptor sites, the turbidity of the water, and the dye concentration in the water. The amount of dye recovered from the charcoal is a function of the amount of charcoal that is eluted, the amount of elutant that is used, and the duration of the elution process. Only the laboratory procedures can be standardized. The dye concentration in elutant is normally reported with the following abbreviations:

ABBREVIATIONS

Dye

-	Negative
?	Questionable Trace
T	Trace
+	Positive
++	Very Positive
+++	Spectacularly Positive

Dye Background

B-	Weak Background
B	Background
B+	Strong Background
B++	Very Strong Background

Detector or Sample

/	Detector not exchanged
NR	Sample Not Recoverable

Dye Type

(F)	Fluorescein
(R)	Rhodamine-WT
(Y)	Direct Yellow 96
(B)	Optical Brightener, FB 28
(E)	Eosine

For purposes of comparison, the peak amplitude recorded for a particular dye in the elutant scans may be given (Fig. 1,) This value is determined by the three point method. Comparisons may be drawn among samples from a single site when flow conditions over the dye detector packet are considered uniform. Comparisons between sites where flow conditions are different are much less valid. Peak amplitudes can be converted to dye concentration. However, there is little to be gained in so doing and the analytical cost is increased very substantially.

Analyses are affected by three principal sources of fluorescence: 1) the general level of fluorescence in the sample (background fluorescence) produced by fluorescence of the water itself and the many compounds it contains, 2) the amount of the dye of interest which is unrelated to that which is purposely injected as part of the tracing program (dye background), and 3) the dye purposely injected. Simple measurements of fluorescence at the maximum emission wavelength for a dye are complicated by the variable level of background fluorescence (Fig. 1, A). Spectrofluorometric scans of a sample show an emission peak when the dye is present (shaded area, Fig. 1, B). The amplitude of the peak can be separated from the background fluorescence by the three point method. This involves extending a line between two points on the emission curve on either side of the emission peak. The peak amplitude (the relative concentration) is measured parallel to the emission (y) axis from the line to the dye peak (Fig. 1, B).

LABORATORY REAGENT BLANKS

Elutant used during the preparation of charcoal packets is analyzed spectrofluorometrically prior to its use on the charcoal packets. One reagent blank determination is made for each batch

of charcoal samples analyzed. Additional blank determinations are made whenever different batches or formulations of elutant are employed.

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Hatcher-Sayre, Howe Valley-Corning Project
Samples dated 6/15/93

H-S Number	Results
1882	-
1883	-
1884	-
1885	-
1886	-
1887	-
1888	-
1889	-
1890	-
1891	-
1892	-
1893	-
1894	-
1895	-
1896	-
1897	-
1898	-
1899	-
1900	-
1901	-

Hatcher-Sayre, Howe Valley-Corning Project
Samples Dated 6/17/93

H-S Number	Results
1902	-
1903	-
1904	-
1905	-
1906	-
1907	-
1908	-
1909	-
1910	-
1911	+
1912	-
1913	-
1914	-
1915	-
1916	-
1917	-
1918	-
1919	-
1920	-
1921	-
1922	+++ (Off Scale at 1000 fluorescence Units)
1923	-

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Hatcher-Sayre, Howe Valley-Corning Project
Samples Dated 6/20/93

H-S Number	Results
1931	-
1932	-
1933	?
1934	+++
1935	+++ (Off Scale at 1000 fluorescence Units)
1936	-
1937	-
1938	-
1939	-
1940	-
1941	+++ (Off Scale at 1000 fluorescence Units)
1942	-
1943	-
1944	-
1945	-
1946	?
1947	-
1948	-
1949	-
1950	-

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Hatcher-Sayre, Howe Valley-Corning Project
Samples Dated 6/25/93

H-S Number	Results
1969	-
1970	+++ (Off Scale at 1000 fluorescence Units)
1971	-
1972	?
1973	-
1974	-
1975	-
1976	+
1977	-
1978	-
1979	-
1980	+++
1981	-
1982	-
1983	-
1984	-
1985	?
1986	-
1987	+++
1988	-
1989	-

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Hatcher-Sayre, Howe Valley-Corning Project
Samples Dated 7/2/93

H-S Number	Results1902
2000	-
2033	-
2034	-
2035	-
2036	-
2037	-
2038	-
2039	++
2040	-
2041	++
2042	-
2043	-
2044	?
2045	-
2046	+++
2047	-
2048	-

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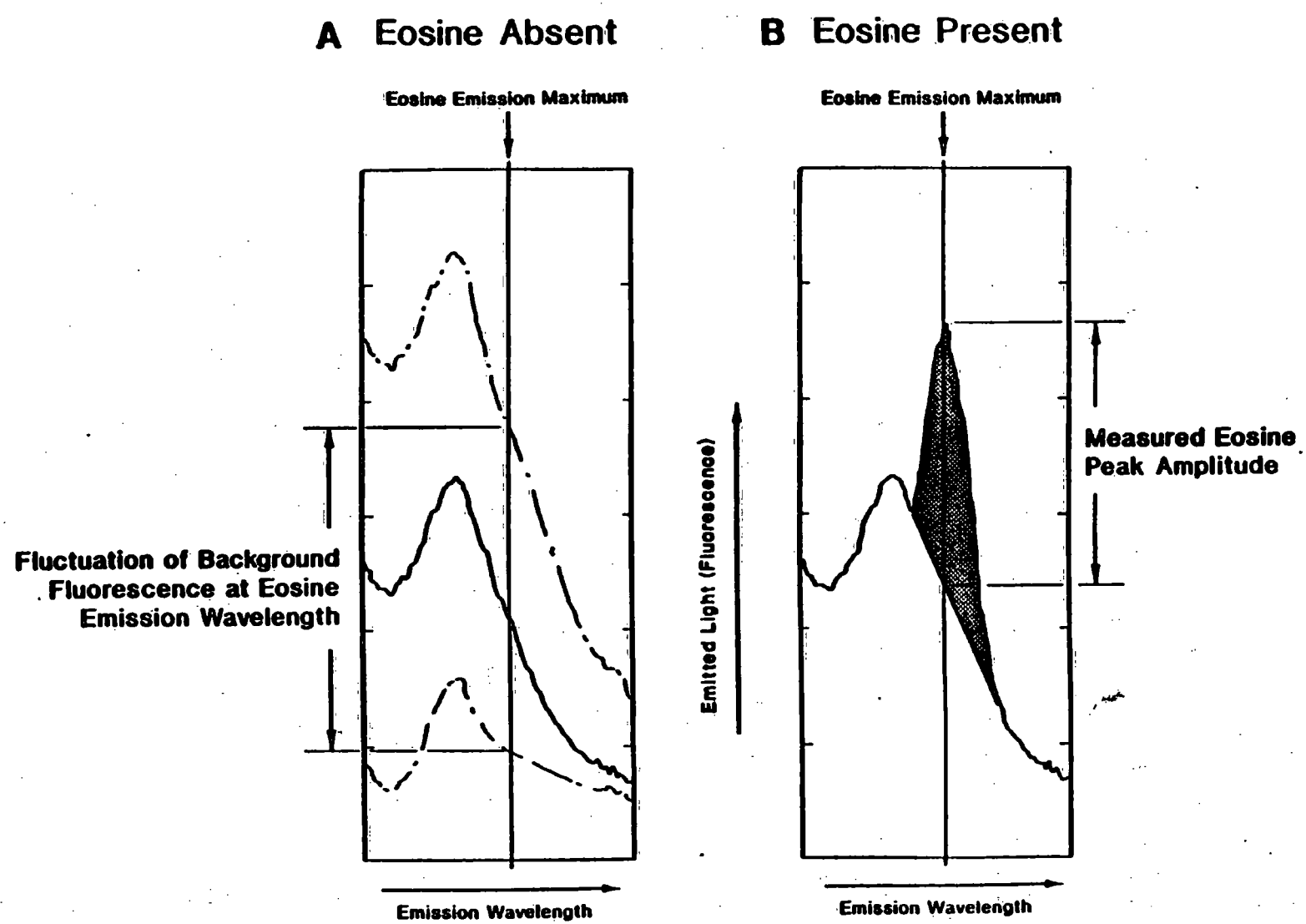
Hatcher-Sayre, Howe Valley-Corning Project
Samples Dated 7/9/93

H-S Number	Results1902
2090	T
2091	T
2092	T
2093	T
2094	T
2095	+

Figure 1 - Detection And Quantification Of Eosine



APPENDIX D

EOSINE OJ DYE MSDS

THRESHOLD LIMIT VALUE.... Ingestion in rats, LD50=4,700 mg/kg
OVER EXPOSURE EFFECTS.... Contact with eyes may result in severe irritation. Contact with skin may result in irritation. Ingest may result in gastric disturbances. Inhalation of dust may irritate respiratory tract.
FIRST AID PROCEDURES..... Flush eyes with flowing water at least 15 minutes. irritation develops, consult a physician. Wash affected skin areas thoroughly with soap and water If irritation develops, consult a physician. Remc and launder contaminated clothing before reuse. If swallowed, dilute with water and induce vomiting. Get immediate medical attention. If inhaled, move fresh air. Aid in breathing, if necessary, and ge medical attention.
NEVER GIVE FLUIDS OR INDUCE VOMITING IF PATIENT UNCONSCIOUS OR HAS CONVULSIONS.

SECTION VI - REACTIVITY DATA

CHEMICAL STABILITY..... Stable
CONDITIONS TO AVOID..... N/A
INCOMPATIBLE MATERIALS... Unknown
DECOMPOSITION PRODUCTS... Carbon monoxide,Carbon dioxide,and oxides of Nitr

HAZARDOUS POLYMERIZATION. Does not occur
POLYMERIZATION AVOID..... N/A

SECTION VII - SPILL OR LEAK PROCEDURE

FOR SPILL ..... Spills should be contained and placed in suitable containers.
WASTE DISPOSAL METHOD.... Do not discharge into sewers or waterways. Dispos in accordance with local regulations.

SECTION VIII - SPECIAL PROTECTION

RESPIRATORY PROTECTION... NIOSH/OSHA approved dust respirator as necessary.
VENTILATION..... Local exhaust to control dusts.
PROTECTIVE GLOVES..... To prevent skin contact.
EYE PROTECTION..... Goggles.
PROTECTIVE EQUIPMENT..... Eye wash fountains should be easily accessible.
HANDLING AND STORAGE..... Keep away from excessive heat and moisture. Keep containers closed.

SECTION IX - SPECIAL PRECAUTIONS

HAZARD CLASS..... N/A
DOT SHIPPING NAME..... Coal Tar Dyestuff

MATERIAL SAFETY DATA SHEET

15189 Eosine OJ

SECTION I - IDENTIFICATION

MANUFACTURER/DISTRIBUTOR. CHEMCENTRAL/Detroit
EMERGENCY PHONE NUMBER... (313) 941-4800
EFFECTIVE DATE..... 10/19/1991
REVISED DATE..... 10/19/1991
CHEMICAL NAME..... Acid Red 87 (Color Index name)
TRADE NAME..... 15189 Eosine OJ
CHEMICAL FAMILY..... Xanthene
CHEMICAL FORMULA..... 45380 (Color Index formula)

SECTION II - HAZARDOUS INGREDIENTS

HAZARDOUS COMPONENTS	HAZARDOUS %	TLV (Units)	PROD. CAS #
None as per part 29 CFR 1910.1200			

SECTION III - PHYSICAL DATA

BOILING Point(F)..... N/A
FREEZING POINT (F)..... N/A
VOLATILITY/VOL(%)..... N/A
MELTING POINT..... N/A
VAPOR PRESSURE (mm Hg)... N/A
VAPOR DENSITY (Air=1).... N/A
SOLUBILITY IN H2O..... Moderate
APPEARANCE/ODOR..... Red powder, no characteristic odor
SPECIFIC GRAVITY (H2O=1). Approximately 1
EVAPORATION RATE..... N/A
PH..... N/A

SECTION IV FIRE & EXPLOSION HAZARD DATA

FLASH POINT..... N/A
LOWER FLAME LIMIT..... N/A
HIGHER FLAME LIMIT..... N/A
EXTINGUISH MEDIA..... Water fog, CO2, or Dry chemical.
FOR FIRE..... Fire fighters should be equipped with self contai breathing apparatus and turnout gear.
UNUSUAL FIRE HAZARD..... Adequate ventilation and clean up must be maintai to minimize dust accumulation. May form explosive dust/air mixture.

SECTION V - HEALTH HAZARD DATA

REPORTABLE QUANTITY (RQ). N/A
UN NUMBER..... N/A
NA #..... N/A
DOT LABELS REQUIRED.....
SPECIAL SHIPPING INSTRUCTIONS:
PACKAGING SIZE..... Various

FOOT NOTES
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N/A = Not applicable

REFERENCES